CoolMOS™ Power Transistor

Features

- Intrinsic fast-recovery body diode
- Extremely low reverse recovery charge
- Ultra low gate charge
- Extreme d*v*/d*t* rated
- High peak current capability
- Qualified according to JEDEC[1)] for target applications

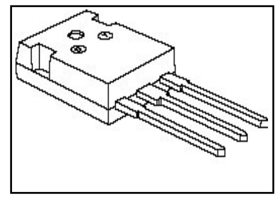
• CoolMOS CFD designed for

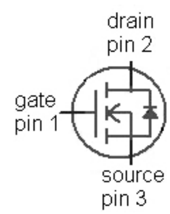
- Softswitching PWM Stages
- LCD & CRT TV

Product Summary

V_{DS} @ Tjmax	650	V
$R_{DS(on),max}$	0.185	Ω
I_D	21.7	A

PG-TO247





Type	Package	Marking
SPW24N60CFD	PG-TO247	24N60CFD

Maximum ratings, at T_j=25 °C, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	T_C=25 °C	21.7	A
		T_C=100 °C	13.7	
Pulsed drain current[2)]	$I_{D,pulse}$	T_C=25 °C	55	
Avalanche energy, single pulse	E_{AS}	I_D=10A, V_{DD}=50 V	780	mJ
Avalanche energy, repetitive[2),3)]	E_{AR}	I_D=20A, V_{DD}=50 V	1	
Avalanche current, repetitive[2),3)]	I_{AR}		20	A
Drain source voltage slope	d*v*/d*t*	I_D=21.7A, V_{DS}=480V, T_j=125°C	80	V/ns
Reverse diode d*v*/d*t*	d*v*/d*t*	I_S=21.7A, V_{DS}=480 V, T_j=125°C	40	V/ns
Maximum diode commutation speed	d*i*/d*t*		600	A/µs
Gate source voltage	V_{GS}	static	±20	V
		AC (*f*>1 Hz)	±30	
Power dissipation	P_{tot}	T_C=25 °C	240	W
Operating and storage temperature	T_j, T_{stg}		-55 ... 150	°C
Mounting torque		M3 & M3.5 screws	60	Ncm

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Thermal characteristics						
Thermal resistance, junction - case	R_{thJC}		-	-	0.52	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wave soldering only allowed at leads	T_{sold}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	°C
Electrical characteristics, at T_j=25 °C, unless otherwise specified						
Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0 V, I_D=250 µA	600	-	-	V
Avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS}=0 V, I_D=21.7 A	-	700	-	
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=1.2 mA	3	4	5	
Zero gate voltage drain current	I_{DSS}	V_{DS}=600 V, V_{GS}=0 V, T_j=25 °C	-	2.5	-	µA
		V_{DS}=600 V, V_{GS}=0 V, T_j=150 °C	-	2600	-	
Gate-source leakage current	I_{GSS}	V_{GS}=20 V, V_{DS}=0 V	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	V_{GS}=10 V, I_D=15.4 A, T_j=25 °C	-	0.15	0.185	Ω
		V_{GS}=10 V, I_D=15.4 A, T_j=150 °C	-	0.42	-	
Gate resistance	R_G	f=1 MHz, open drain	-	0.8	-	
Transconductance	g_{fs}	$\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, I_D=15.4 A	-	14.0	-	S

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Dynamic characteristics						
Input capacitance	C_{iss}	V_{GS}=0 V, V_{DS}=25 V, f=1 MHz	-	3160	-	pF
Output capacitance	C_{oss}		-	900	-	
Reverse transfer capacitance	C_{rss}		-	34	-	
Effective output capacitance, energy related[4]	$C_{o(er)}$	V_{GS}=0 V, V_{DS}=0 V to 480 V	-	103	-	
Effective output capacitance, time related[5]	$C_{o(tr)}$		-	188	-	
Turn-on delay time	$t_{d(on)}$	V_{DD}=400 V, V_{GS}=10 V, I_D= 21.7A, R_G=6.8 Ω	-	50	-	ns
Rise time	t_r		-	24	-	
Turn-off delay time	$t_{d(off)}$		-	100	-	
Fall time	t_f		-	9	-	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DD}=480 V, I_D=21.7 A, V_{GS}=0 to 10 V	-	15	-	nC
Gate to drain charge	Q_{gd}		-	67	-	
Gate charge total	Q_g		-	110	143	
Gate plateau voltage	$V_{plateau}$		-	7.3	-	V

[1] J-STD20 and JESD22

[2] Pulse width t_p limited by $T_{j,max}$

[3] Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR}*f$.

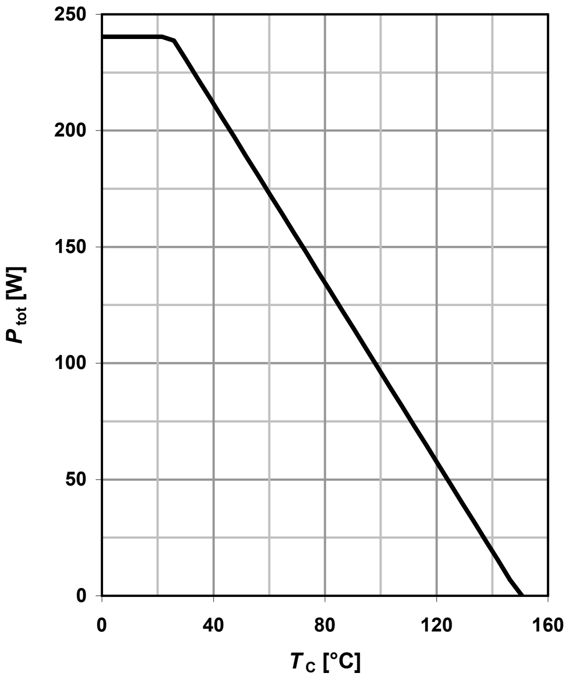
[4] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

[5] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 80% V_{DSS}.

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Reverse Diode						
Diode continuous forward current	I_S	T_C=25 °C	-	-	21.7	A
Diode pulse current[2)]	$I_{S,pulse}$		-	-	55	
Diode forward voltage	V_{SD}	V_{GS}=0 V, I_F=I_S, T_j=25 °C	-	1.0	1.2	V
Reverse recovery time	t_{rr}	V_R=480 V, I_F=I_S, di_F/dt=100 A/µs	-	140	-	ns
Reverse recovery charge	Q_{rr}		-	0.9	-	µC
Peak reverse recovery current	I_{rrm}		-	11	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	T_j=25 °C	-	1400	-	A/µs

1 Power dissipation

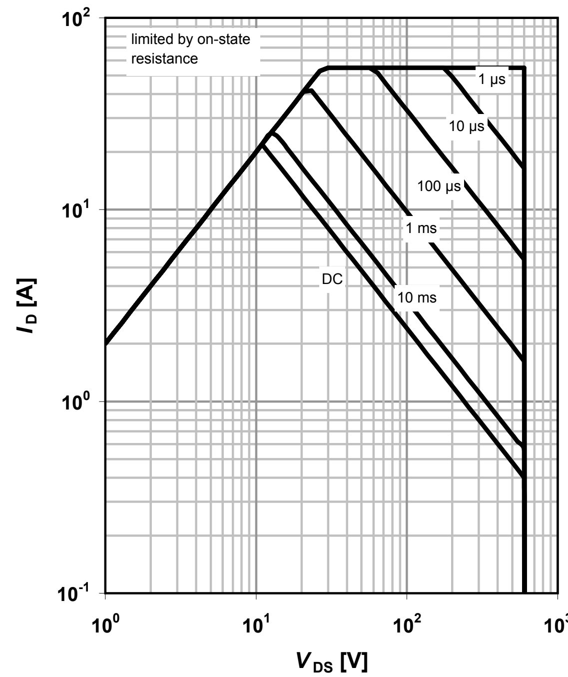
P_{tot}=f(T_C)



2 Safe operating area

I_D=f(V_{DS}); T_C=25 °C; D=0

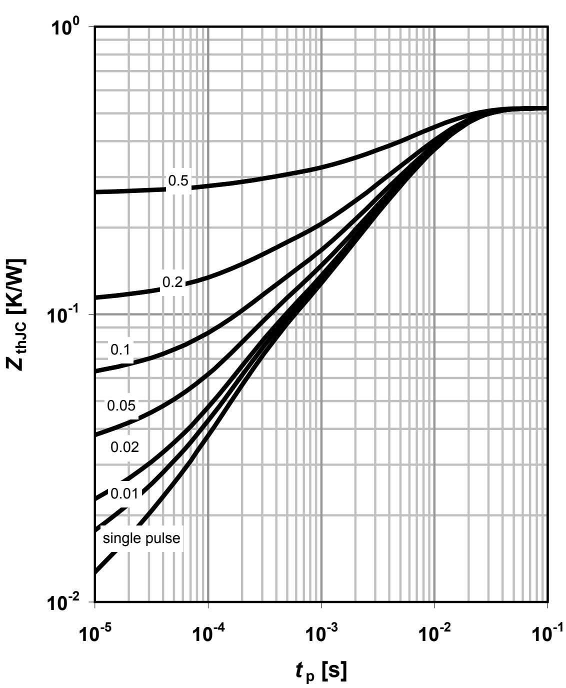
parameter: t_p



3 Max. transient thermal impedance

I_D=f(V_{DS}); T_j=25 °C

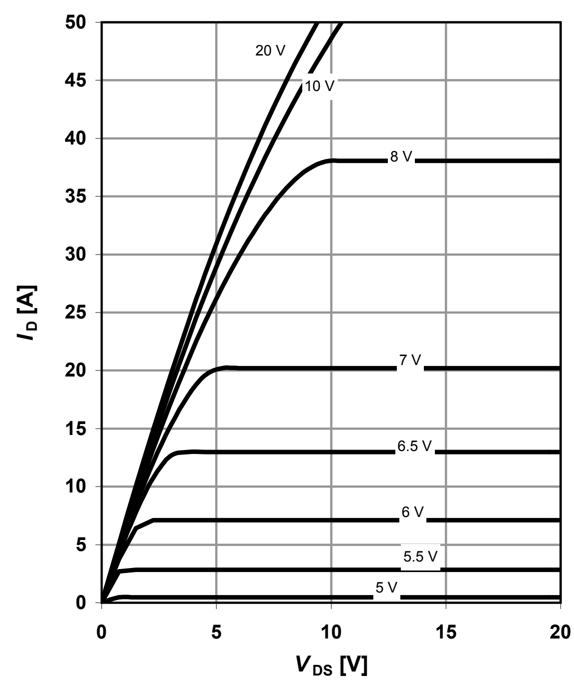
parameter: D=t_p/T



4 Typ. output characteristics

I_D=f(V_{DS}); T_j=25 °C

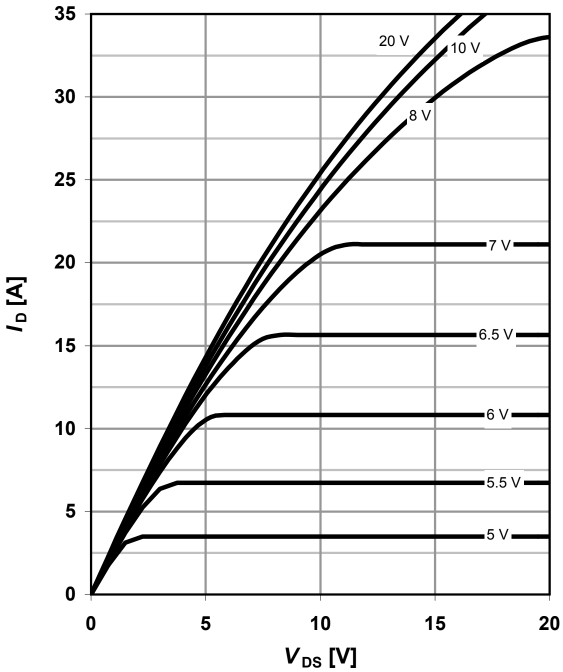
parameter: V_{GS}



5 Typ. output characteristics

I_D=f(V_{DS}); T_j=150 °C

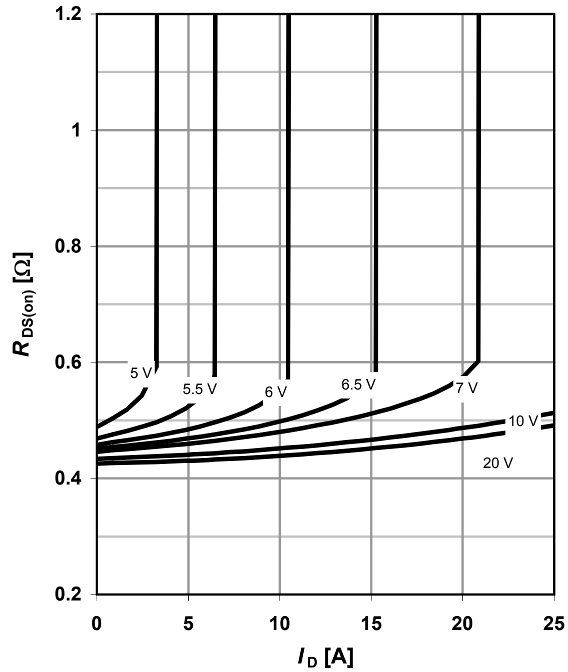
parameter: V_{GS}



6 Typ. drain-source on-state resistance

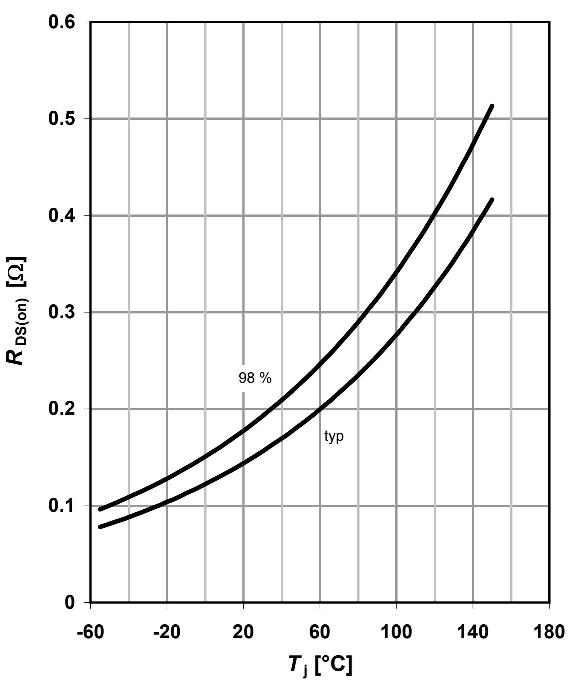
$R_{DS(on)}$=f(I_D); T_j=150 °C

parameter: V_{GS}



7 Drain-source on-state resistance

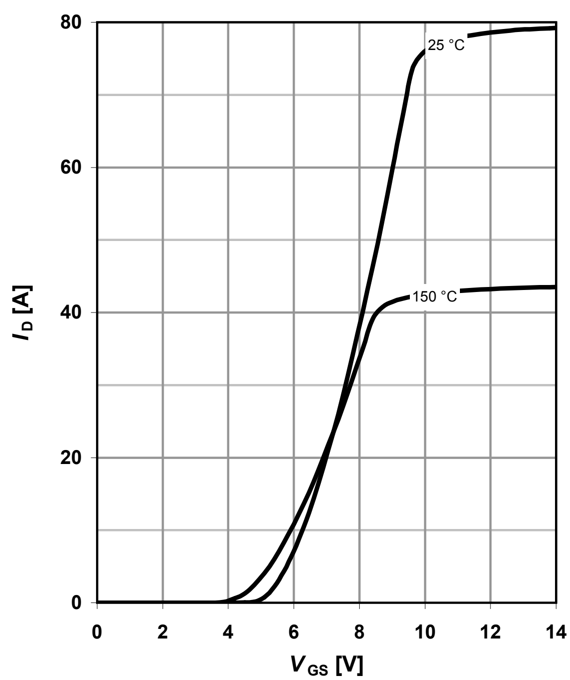
$R_{DS(on)}$=f(T_j); I_D=15.4 A; V_{GS}=10 V



8 Typ. transfer characteristics

I_D=f(V_{GS}); $|V_{DS}|$>2$|I_D|R_{DS(on)max}$

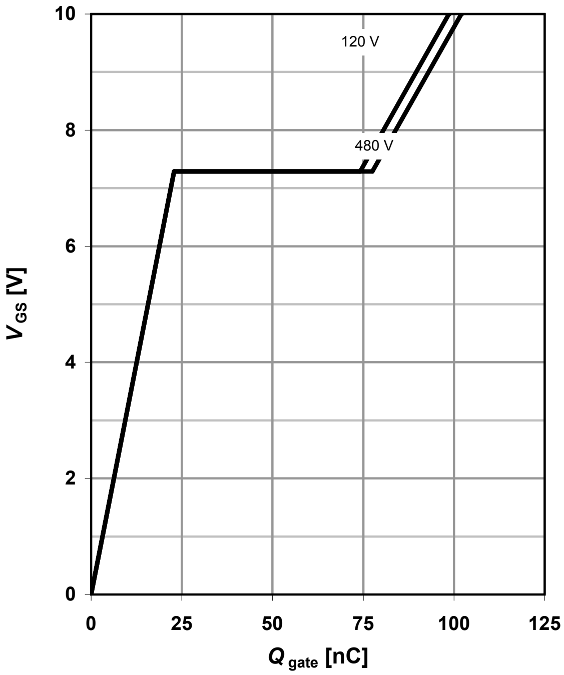
parameter: T_j



9 Typ. gate charge

V_{GS}=f(Q_{gate}); I_D=21.7 A pulsed

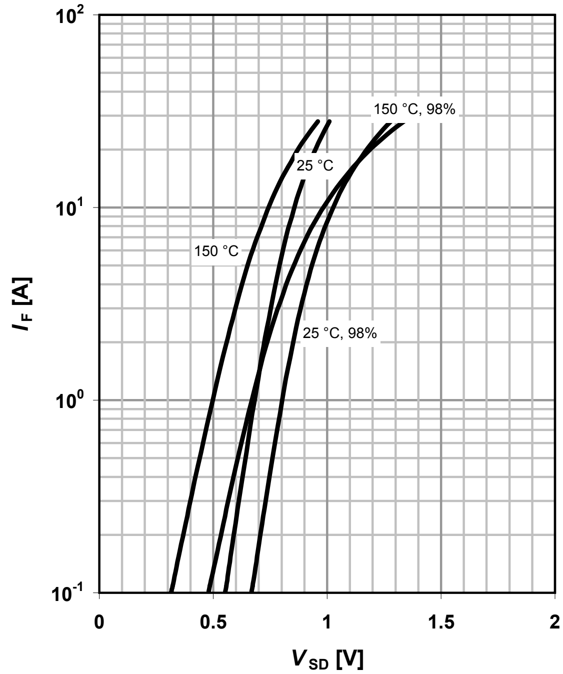
parameter: V_{DD}



10 Forward characteristics of reverse diode

I_F=f(V_{SD})

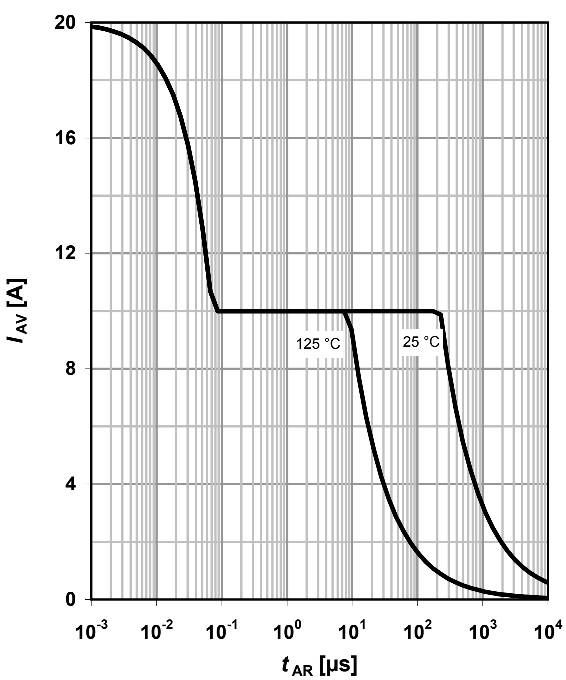
parameter: T_j



11 Avalanche SOA

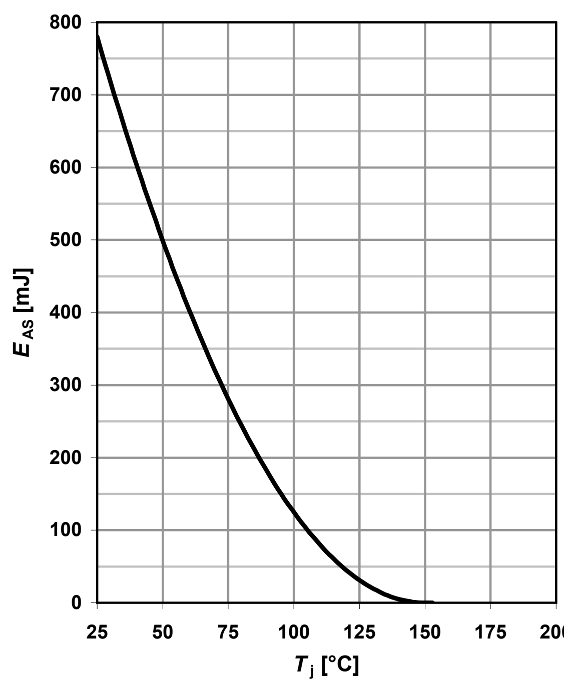
I_{AR}=f(t_{AR})

parameter: $T_{j(start)}$



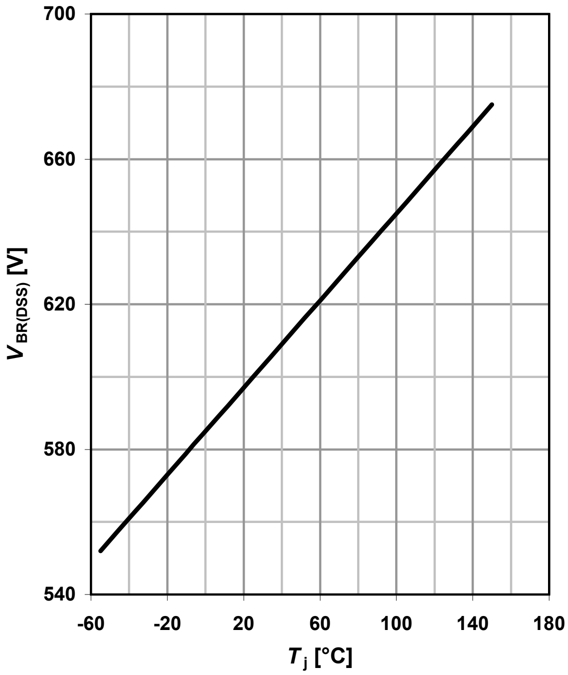
12 Avalanche energy

E_{AS}=f(T_j); I_D=10 A; V_{DD}=50 V



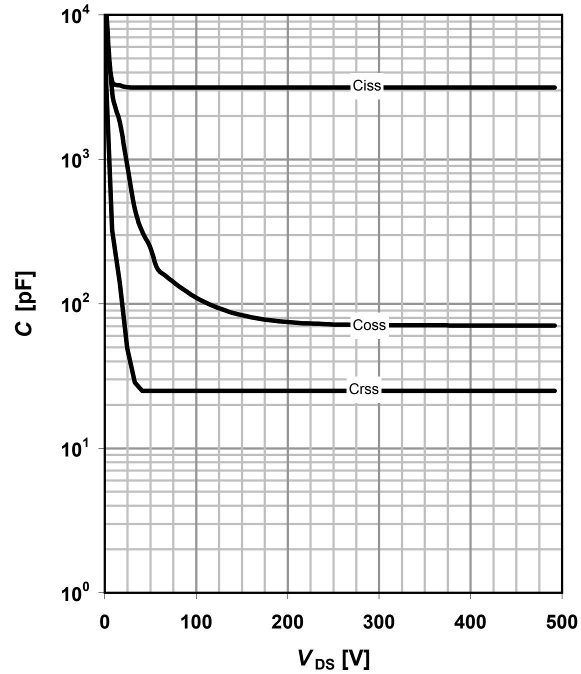
13 Drain-source breakdown voltage

$V_{BR(DSS)}$=f(T_j); I_D=10 mA



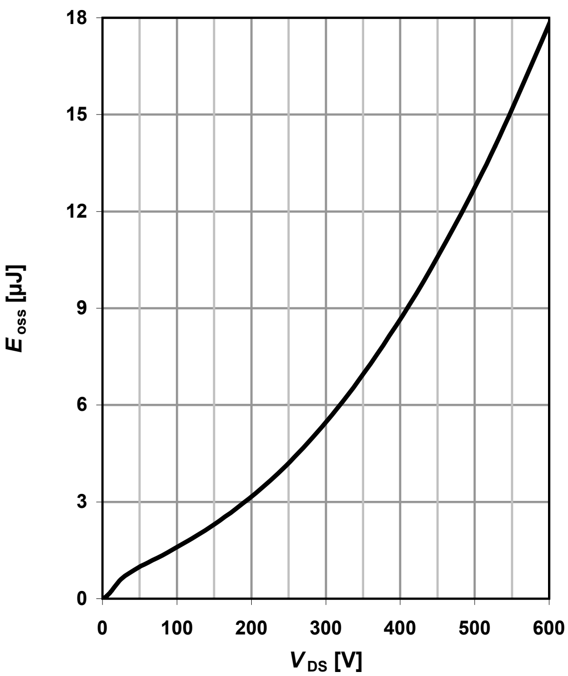
14 Typ. capacitances

C=f(V_{DS}); V_{GS}=0 V; f=1 MHz



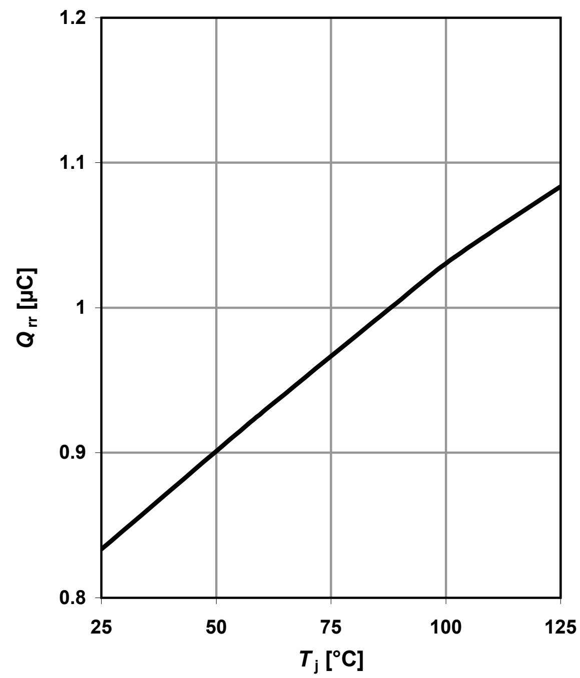
15 Typ. C_{oss} stored energy

E_{oss}= f(V_{DS})



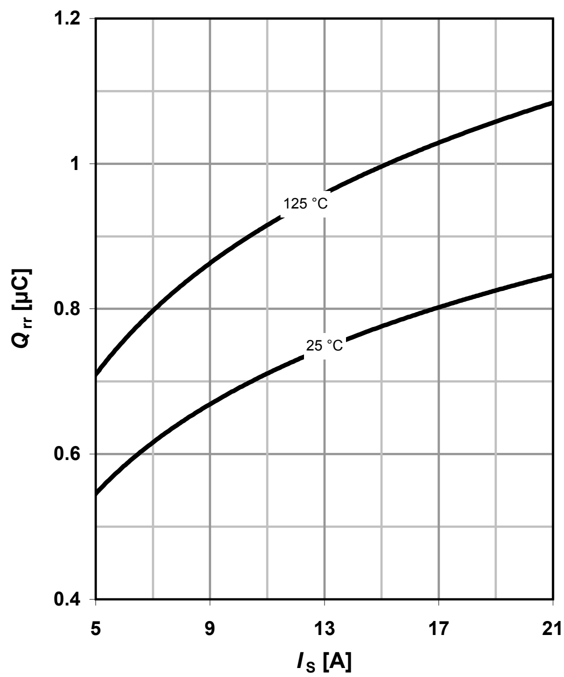
16 Typ. reverse recovery charge

Q_{rr}=f(T_j);parameter: I_D =21.7 A



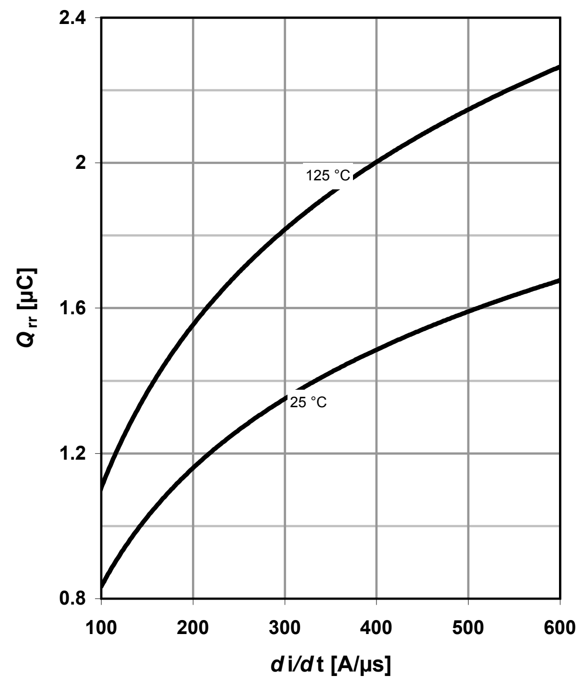
17 Typ. reverse recovery charge

Q_{rr}=f(I_S); parameter: di/dt=100 A/µs

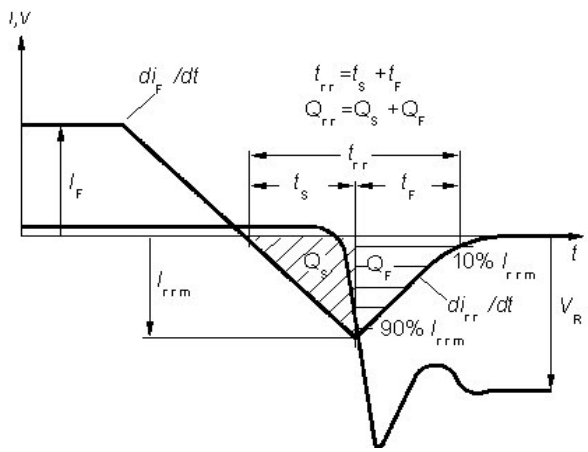


18 Typ. reverse recovery charge

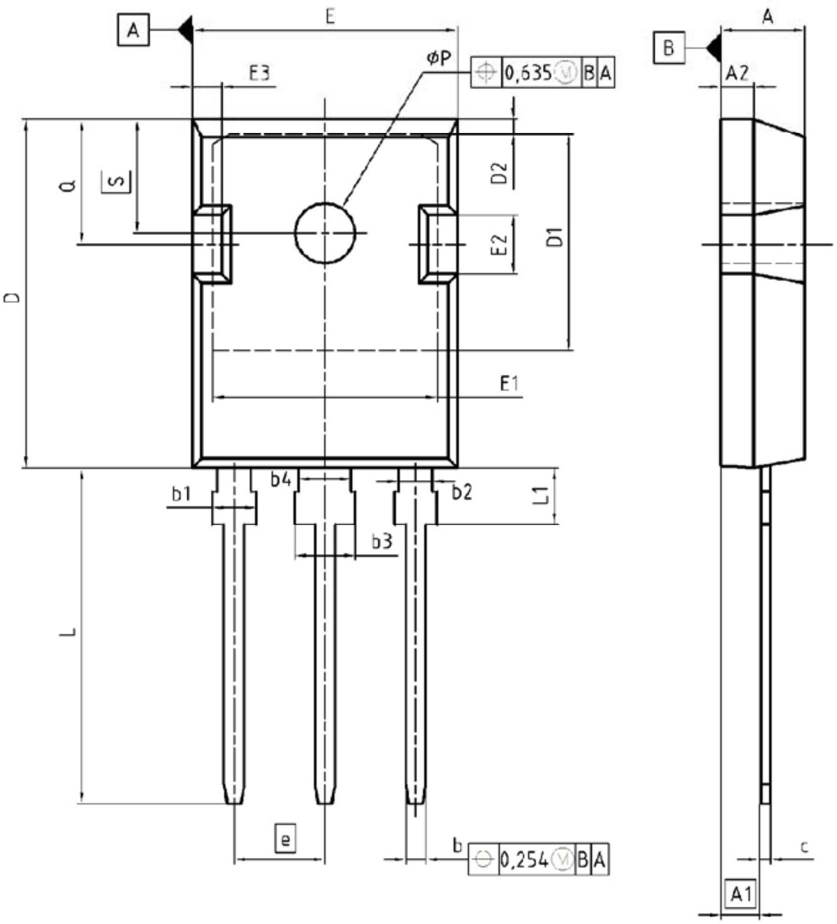
Q_{rr}=f(di/dt); parameter: I_D=21.7 A



Definition of diode switching characteristics



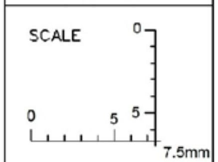
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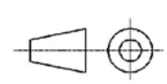
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.16	0.193	0.203
A1	2.27	2.53	0.089	0.099
A2	1.85	2.11	0.073	0.083
b	1.07	1.33	0.042	0.052
b1	1.90	2.41	0.075	0.095
b2	1.90	2.16	0.075	0.085
b3	2.87	3.38	0.113	0.133
b4	2.87	3.13	0.113	0.123
c	0.55	0.68	0.022	0.027
D	20.82	21.10	0.820	0.831
D1	16.25	17.65	0.640	0.695
D2	1.05	1.35	0.041	0.053
E	15.70	16.03	0.618	0.631
E1	13.10	14.15	0.516	0.557
E2	3.68	5.10	0.145	0.201
E3	1.68	2.60	0.066	0.102
e	5.44		0.214	
N	3		3	
L	19.80	20.31	0.780	0.799
L1	4.17	4.47	0.164	0.176
øP	3.50	3.70	0.138	0.146
Q	5.49	6.00	0.216	0.236
S	6.04	6.30	0.238	0.248

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SCALE



EUROPEAN PROJECTION



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